INSECT FAUNA OF THE AUSTRALIAN NOXIOUS WEED *EMEX AUSTRALIS* STEINHEIL IN THE WESTERN CAPE, SOUTH AFRICA

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Abstract

Emex australis Steinheil is a polygonaceous plant of South African origin and a noxious weed in Australia, especially of irrigated vineyards in Victoria. Surveys were carried out in the Western Cape, South Africa to determine the fauna of *E. australis*. Seventeen species of Lepidoptera, three species of Coleoptera and two species of Hemiptera were collected, most of which were polyphagous. Only one possibly new host specific insect was found *Rhodometra sacraria* (L.) Two insects, *Perapion antiquum* (Gyllenhal) and *Microthrix inconspicuella* Ragonot, considered to be host specific, were collected and reared, the former for reintroduction into Australia as a biological control agent for *E. australis* and the latter for further host specificity tests.

Introduction

In South Africa two insects, *Microthrix inconspicuella* Ragonot (Lepidoptera: Pyralidae) and *Perapion antiquum* (Gyllenhal) (Coleoptera: Curculionidae) are natural enemies of *Emex australis* Steinheil (Neser 1979). They have been considered for introduction to Australia as biological control agents for *E. australis* which is a serious weed. Only *P. antiquum* has been released to date. The fauna of *E. australis* in Australia is limited; no insects have been recorded which damage the plant, but some polyphagous Lepidoptera have been found to feed occasionally on the leaves (G. Buchanan pers. comm.).

In 1977, *M. inconspicuella* was introduced into quarantine by the Commonwealth Scientific Industrial Research Organisation (CSIRO), Brisbane to evaluate its potential as a biological control agent (Harley *et al.* 1979). During host specificity tests, *M. inconspicuella* larvae fed and completed their development on young leaves of the apple variety Tropical Beauty (R. Kassulke pers. comm.). Limited feeding also occurred on the related polygonaceous plants, rhubarb (*Rheum raponticum* auct. non. L.) and buckwheat (*Fagopyrum esculentum* Moench). The culture was therefore destroyed. In South Africa no apple damage by *M. inconspicuella* larvae was observed, even when *E. australis* grew in apple orchards. Research on *M. inconspicuella* was resumed in South Africa in 1983 to determine whether *M. inconspicuella* larvae were capable of feeding on apple plants in the field.

P. antiquum was first introduced into the Hawaiian Islands from Natal, South Africa in 1956/1957 (Krauss 1963), and quickly established. It is now considered a successful control agent against *Emex* spp. in Hawaii (Nakao 1969). Host specificity tests in Australia showed that *P. antiquum* had a limited host range (Harley and Kassulke 1975) and consequently field releases were made. Establishment has occurred at a number of sites but *E. australis* has not been

successfully controlled (Julien and Bourne 1983). The more recent introductions from the Clanwilliam area of South Africa to Loxton, South Australia and Mildura, Victoria have proved more successful (G. Buchanan pers. comm.), but the plant has not yet been successfully controlled.

In order to carry out orchard experiments with *M. inconspicuella* and introduce into Australia more suitable biotypes of *P. antiquum*, collections of both insects were made in the Western Cape in 1983-1984. At the same time surveys for other host specific insects which could be used as biological control agents in Australia were carried out.

Methods

Specimens of *E. australis* were collected from coastal and semi-arid areas of the Western Cape, of climatic type III_4 (Walter and Lieth 1960), having Fynbos and Karroid Broken Veld vegetation/soil types (Acocks 1975), and also from Upington, of climatic type III_1. Upington is the only area in the arid/semi-arid region where vineyards are irrigated in summer, and is similar to Mildura, Victoria, (climatic type III_3) where the weed is of economic importance.

Plants were dug up and examined for evidence of leaf feeding or root damage. The presence or absence of insects as well as the location of plants was noted. Collections from 37 locations were made during September-December when plants were mature, and during April-July when seedlings and young plants were present. Adult insects were collected by sweeping plants with insect nets and from light traps set up in vineyards, wheat fields and wastelands.

Plant material was returned to the laboratory in Stellenbosch and placed in emergence boxes and insects collected for identification or culturing. Insects were sent to the National Collection of Insects, Plant Protection Research Institute, Pretoria for identification.

Results and Discussion

Results of the survey are shown in Table 1. Only three insects, restricted to *E. australis* or other polygonaceous plants were cultured. These were *M. inconspicuella*, *P. antiquum* and *Rhodometra sacraria* (L.). Most insects found were polyphagous leaf feeders, and included 17 species of Lepidoptera, three Coleoptera and two Hemiptera. More species were collected during spring-summer than autumn-winter, and by plant collections than with light traps. Seven species of moths were collected as adults using light traps, usually Lepidoptera were collected as larval leaf feeders. The weevil, *Rhytirrhinus inaequalis* (F.), collected in Grahamstown from the roots of *E. australis* (J. Scott pers. comm.) was not found in the Western Cape region. Soil types differ between these two regions (Acocks 1975) which may account for differences in distribution as *R. inaequalis* pupates in the soil. The records of the South African Museum, Cape Town did not indicate the presence of *E. australis* specific insects other than *M. inconspicuella* and *P. antiquum*. *R. sacraria* was recorded on *Polygonum* spp. (M. Whitehouse pers. comm.).

R. sacraria has been recorded as a feeder of polygonaceous plants in South Africa (G. Prinsloo pers. comm.) and from *Anthemis* sp. (Asteraceae), *Rhus* sp. (Anacardiaceae) as well as from *Polygonum* sp. (Polygonaceae) (Pinhey 1975; Laithwaite *et al.* 1975). It is considered as migratory in South Africa (G. Prinsloo pers. comm.) and Europe (Pinhey 1975). Larvae were found feeding on *E. australis* plants during late spring in the Clanwilliam region and adults were commonly found in Stellenbosch during late summer-autumn.

Host specificity tests on *R. sacraria* were carried out in Stellenbosch and under quarantine conditions in Frankston, Australia. Although *R. sacraria* had not been exposed to Australian native Polygonaceae before, they oviposited on and defoliated several of these species, as well as introduced polygonaceous species other than *E. australis*. *R. sacraria* is therefore family rather than species specific.

M. inconspicuella has been recorded from *E. australis* in southern Africa, and present on *Rumex pulcher* L. in the Stellenbosch region (Neser 1979). Areas where this insect was found are shown in Fig. 1. *M. inconspicuella* does not successfully control its host plant in South Africa, but the reason could be the presence of a large number of parasitoids. These included unidentified genera of Ichneumonidae and Braconidae as well as *Habrocytus* sp. (Pteromelidae), *Apanteles* spp. (Braconidae), *Entedon* spp. (Eulophidae) and *Hakeria* sp. (Chalcidae) (Id. G.L. Prinsloo, PPRI, Pretoria); *Chriodes* sp. and *Telmelucha* sp. (Ichneumonidae), unidentified genus ex *Apanteles* (Braconidae) (Id. J.S. Donaldson, PPRI, Pretoria).

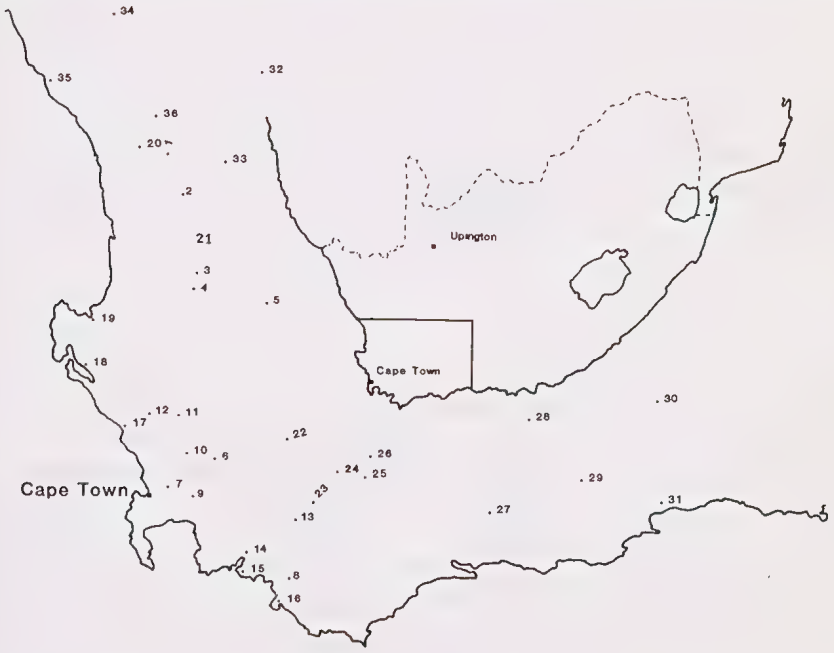

Fig. 1. Map of South Africa with the Western Cape region. Areas from which *Microthrix inconspicuella* was collected: 1. Trawal; 2. Clanwilliam; 3. Citrusdal; 4. Eendekuil; 5. Grootrivier; 6. Paarl; 7. Brackenfell; 8. Stanford; 9. Stellenbosch; 10. Klipheuwell; 11. Malmsbury; 12. Mamre; 13. Modderasrivier; 14. Botrivier. Areas from which *M. inconspicuella* was not collected: 15. Hawston; 16. Frankskaal; 17. Darling; 18. Veldrift; 19. Langebaan; 20. Klawer; 21. Algeria; 22. Worcester; 23. Nuy; 24. Robertson; 25. Ashton; 26. Montaque; 27. Heidelburg; 28. Ladismith; 29. Gourtis Rivier; 30. Oudtshoorn; 31. Mossel Baai; 32. Calvinia; 33. Wupetal; 34. Springbok; 35. Hondeklip; 36. Vanrhynsdorp. Upington.

Table 1. List of species associated with *Emex australis*

Insects collected	Location*	Month of Collection	General Information (Anneke & Moran 1982; Phiney 1975)
Lepidoptera			
Colias electo electo (L.) f *aurivilluis* Kerferst (Pieridae)#[1]	1,3	vii,x,xi	Lucerne butterfly. Straggler, widespread pest.
Pontia helice (L.) (Pieridae)[1]	7	x,xi	Straggler, larvae feed on plants of Cruciferaceae, Loranthaceae, Santalaceae, Capparidaceae.
Species unknown (Geometridae: Larentiinae)[1]	1	ix	Straggler, leaf feeder.
Rhodometra sacraria (L.) (Geometridae)	1,2,3,5,8,9	iii,iv,v,viii, x,xi,xii	Velvet moth. Larva defoliator of plants of Polygonaceae.
Udea ferruginalis (Hubner) (Pyraustidae)#[1]	2,5	v,x	Straggler, larvae feed on *Erigeron* sp. Widespread in southern Africa.
Epichoristodes acerbella (Walker) (Pyraustidae)[1]	2,3,5,11 Upington	x,xi,xii	Straggler, leaf feeder.
Bracharoa dregei (Herrich-Schaffer) (Lymantriidae)[1]	11,14	x,xi	Straggler, larvae feed on *Osteospernum* sp. in South West Cape.
Mythimna (*Acantholeucania*) *lorei* (Duponchel) (Noctuidae)#	1	ix	Straggler, leaf feeder.
Spodoptera exigua (Hubner) (Noctuidae)#	1,2,3,4,5	v,vii,ix,x, xi,xii	Lesser Army worm. Straggler, pest of peas, cotton, maize, lucerne, tobacco, potatoes, tomatoes.
Agrotis segetum (Denis-Schiffermiller) (Noctuidae)#[1]	2,5	vii,x	Common cutworm. Straggler, pest of vegetables, cereals, cotton, tobacco.

Earias insulana (Boisduval) (Noctuidae)#[1]	1 Upington	x, xi, xii	Spiny bollworm. Straggler, pest of cotton and other malvaceous plants.
Syngrapha circumflexa (L.) (Noctuidae)#[1]	1,2	v,vii,viii,xii	Straggler, larvae feed on potato leaves and *Eschscholzia* sp.
Heliothis armigera (Hubner) (Noctuidae)	1,2	viii,x,xii	American bollworm. Straggler, polyphagous pest of agriculture.
Celama meridionalis (Wallengren) (Nolidae)[1]	2,8	x,xii	Straggler, nolid larvae feed mainly on lichens, on the leaf surface.
Hippotion celerio (L.) (Sphingidae)[3]	1	ix	Silver-striped hawk moth. Straggler, pest of young vine leaves.
Plutella xylostella (Plutellidae)	2,3,5	x	Diamond-back moth. Straggler, pest of brassicas and cultivated crucifers.
Microthrix inconspicuella Ragonot (Pyralidae)	1-14	v,vi,ix,x,xi	Larval defoliator of *E. australis*.
Coleoptera			
Eremnus prob. *frugalis* Boheman (Curculionidae)[2]	2,14	v,xi	Snout beetle. Straggler, pest of vines and pome fruit.
species? (Curculionidae: Alticinae)[2]	3,9	x	Feeds on leaves of plants of Polygonaceae, shot hole damage.
Perapion antiquum (Gyllenhal) (Curculionidae)[2]	1,2,3,10 n, Upington	v,vi,viii,x	Stem weevil of *E. australis*.
Hemiptera			
Orius thripoborus (Hesse) (Anthocoridae)[4]	1	xii	Straggler, predator on thrips.
Phenococcus solani Ferris (Coccidae)[5]	9	i,ii,iii, xi,xii	Straggler, on roots, polyphagous on garden plants, vines.

* numbers refer to Fig. 1;

adults collected using light trap;

1. Id. L. Vari, Transvaal Museum;
2. Id. R. Oberprieler, PPRI, Pretoria;
3. Id. N.M. Swain, PPRI, Pretoria;
4. Id. I.M. Miller, PPRI, Pretoria;
5. Id. D.J. Williams, CIE, London.

Despite these parasitoids *E. australis* can be heavily damaged by *M. inconspicuella* when larvae are in sufficiently high numbers to feed on the leaves, flowers and young achenes. *M. inconspicuella* was more commonly found on large plants growing in sandy soil in disturbed areas, such as roadsides, waste lands and the edge of crops, but not in areas where the plant was smaller, i.e. in less disturbed areas (Gourtis River, Heidelburg); near the sea (Hawston, Hondeklip, Frankskaal, Langebaan); and in arid areas (Calvinia, Wupetal, Springbok, Vanrhynsdorp).

Other insects collected on *E. australis* were cosmopolitan defoliators which normally attack the crop species growing in the vicinity (Anneke and Moran 1982, Pinhey 1975). Opportunistic feeders and stragglers would not be considered as biological control agents. Many of the insects collected are already present in Australia and are opportunistic feeders on *E. australis*.

The only insect found on roots was the mealy bug, *Phenacoccus solani* Ferris, a fairly new arrival in South Africa and found occasionally on chrysanthemum, gerbera and amaryllis plants (Annecke and Moran 1982). It is a polyphagous species and of no use as a biological control agent (D. Williams pers. comm.).

The only new and likely biological control agent for *E. australis* found during these surveys was *R. sacraria*, but this insect proved not to be as specific as hoped (Shepherd 1989) and will not be introduced as a biological control agent.

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References

ACOCKS, J.P.H. 1975. Veld types of South Africa. *Memoirs of the Botanical Society of South Africa*, No. 40.

ANNEKE D.P. and MORAN, V.C. 1982. 'Insects and Mites of Cultivated Plants in South Africa.' Butterworth & Co. (SA) (Pty.) (Ltd.), Durban.

HARLEY, K.L.S. and KASSULKE, R.C. 1975. *Apion antiquum* (Curculionoidea: Apionidae) for biological control of the weed *Emex australia*. *Journal of the Australian Entomological Society*, 14: 271-276.

HARLEY, K.L.S., KASSULKE, R.C. and JULIEN, M.H. 1979. Biology and host specificity of *Microthrix inconspicuella* Ragonot (Lepidoptera: Pyralidae), a natural enemy of *Emex australis* in South Africa. *Journal of the Entomological Society of Southern Africa* 42: 343-348.

JULIEN, M.H. and BOURNE, A.S. 1983. Temperature relations of *Perapion antiquum* (Col., Curculionidae), a weevil introduced to control the weed *Emex australis* in Australia. *Zeitschrift für angewandte Entomologie* 95: 351-360.

KRAUSS, N.K.L. 1963. Biological control investigations on Christmas berry (*Schinus terebinthifolius*) and Emex (*Emex* spp.). *Proceedings of the Hawaiian Entomological Society* 18: 281-287.

LAITHWAITE, E., WATSON, A. and WHALLY, P.E.S. 1975. 'The Dictionary of Butterflies and Moths in Colour.' E.J. Duckworth, W.D. Michael Joseph, London.

NAKAO, H.K. 1969. Biological control of weeds in Hawaii. *Proceedings First Asian-Pacific Weeds Control Interchange, Hawaii* : 93-95.

NESER, S. 1979. Observations in South Africa on *Microthrix inconspicuella* Ragonot (Phycitinae: Pyralidae), a natural enemy of *Emex australis* Steinheil. *Journal of the Entomological Society of Southern Africa* 42: 337-342.

PINHEY, E.C.G. 1975. 'Moths of Southern Africa.' Descriptions and Colour illustrations of 1183 species. Tafleburg. Cape Town.

SHEPHERD, R. C. H. (In Press). Host Specificity Testing of *Rhodometra sacraria* (L.) (Lepidoptera: Geometridae), a Possible Biological Control Candidate for *Emex australis* Steinheil in Australia. *Entomophaga.*

WALTER, H. and LIETH, H. 1960. 'Klimadiagramm Weltatlas.' Veb Gustav Fisher, Verlag, Jena.

BOOK REVIEW

Portraits of South Australian Geometrid Moths. By N. McFarland. I-IV + 400 pages, paperback, 26x35cm. Price $US85 including surface postage to Australia and packing. Privately published, printed by Allen Press, Lawrence, Kansas, August 1988. Available from N. McFarland, P.O. Box 1404, Sierra Vista, Arizona 85636, USA.

In 1964 Noel McFarland became assistant entomologist at the South Australian Museum. In the following six years he pursued an intensive study of the early stages of Lepidoptera mostly around Adelaide. He became well known for his penetrating and thorough observations and the magnificent collection of preserved larvae and pupae that he built up. The massive documentation, in notes and in photographs, which lay behind his work has been largely unavailable until now. It is no secret that Noel preferred to study families with larvae which rested openly on the vegetation during the day and his greatest and most enthusiastic attention was given to the Geometridae. To successfully rear Lepidoptera they must have first call on one's time and Noel was fortunate in being able to do most of his work at home. Here also he collected many of the female moths whose eggs commenced his cultures and whose presence indicated the local availability of foodplants. On leaving the South Australian Museum in 1970 he continued rearing moths at Geraldton, W.A. for some years until returning to the United States. This book is the culmination of his six years work in Adelaide.

The core of the book is a series of comprehensive black and white photographs of eggs, larvae, pupae, living adults and pinned adults of each of the 72 species included. The photographs of each species are accompanied by a detailed text. Do not be misled by the title as the text is as important as the pictures. It is detailed and based almost entirely on first hand observations. The photographs are uniformly excellent, well reproduced, and as they are large show detail well. Multiple photographs illustrate each stage from different angles and in different poses.